

Rec'd PTO 11 APR 2005

#8

66722-057-7

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In-re Application of:)	PATENT
)	Confirmation No. 3799
Steen RASMUSSEN)	
)	Customer No. 25269
Serial No.: 10/501,224)	
)	
Filed: July 12, 2004)	

For: **PIÉZO ELECTRIC PUMP AND
DEVICE WITH SUCH PUMP**

PETITION UNDER 37 C.F.R. §1.47(b)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

April 11, 2005

Sir:

It is hereby requested that the attached Combined Declaration and Power of Attorney for Utility Patent Application, submitted in accordance with the requirement for such submission in Form PCT/DO/EO/905, issued January 21, 2005 (copy attached), be accepted so as to complete the filing requirements under 37 C.F.R. §371. A Petition for Extension of Time and a Fee Letter are also attached.

Mr. Steen Barbrand Rasmussen, the inventor, has refused to sign the Combined Declaration and Power of Attorney. In this regard, an executed Statement Under 37 C.F.R. §1.47(b) is attached setting forth the pertinent facts.

05/20/2005 CSMOOT 00000001 042223 10501224
Sale Ref: 00000001 DAB: 042223 10501224
01 FC:1463 200.00 DA

In addition, the undersigned has received a telefax directly from Mr. Rasmussen transmitting copies of the Declaration and Assignment for this

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application and on which he has indicated in writing his refusal to sign. A copy of this telefax with attachments is attached.

Mr. Rasmussen's last known address is:

Birkholmvej 1
DK-3540 Lyngbe
Denmark

The petition fee (\$130.00) should be charged to Deposit Account No. 04-2223.

Respectfully submitted,

DYKEMA GOSSETT PLLC

By: 

Richard H. Tushin
Registration No. 27,297
Franklin Square, Third Floor West
1300 I Street, N.W.
Washington, DC 20005-3353
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Rec'd PTO

11 APR 2005

66722-057-7

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In-re Application of:) PATENT
)
Steen Barbrand RASMUSSEN) GROUP:
)
Serial No.: (PCT/DK03/00011)) EXAMINER:
10/501,224)
) CUSTOMER NO.: 25269
)
Filed: (9 January 2003))
)
PIEZO ELECTRIC PUMP AND DEVICE
WITH SUCH PUMP

* * * * *

STATEMENT UNDER 37 C.F.R. 1.47(b)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Mikael T. Christensen, hereby declare and state as follows:

1. I am head of the patent department of Oticon A/S, located at Strandvejen 58, DK-2900 Hellerup, Denmark.

2. I prepared and filed an international patent application entitled "Piezo Electric Pump and Device with Such Pump, which was assigned application number PCT/DK03/00011, on behalf of Steen Brabrand Rasmussen as inventor, and Interacoustics A/S of Drejervaenget 8, DK-Assens, Denmark, as applicant, on 9 January 2003. Interacoustics A/S is an affiliate of Oticon A/S.

3. On 30 June 2004 I wrote to Richard H. Tushin of Dykema Gossett, Franklin Square, Third Floor West, 1300 I Street, N.W.,

Washington, D.C. 20005 and asked him to file a U.S. national phase application based on PCT/DK03/00011. I did not have an executed Declaration and Power of Attorney to forward to Mr. Tushin for filing. I was later informed that U.S. national phase filing was accomplished on July 12, 2004.

4. On February 2, 2005 I sent a letter to the inventor conveying a complete copy of the specification, claims and drawings of PCT/DK03/00011 (WO 03/058067), as well as a Declaration and Assignment for signing, wherein I asked Mr. Rasmussen to review the application and then sign and return the Declaration and Assignment by February 16, 2005. No reply was received.

5. On February 21, 2005 I sent another letter to the inventor conveying a complete copy of the specification, claims and drawings of PCT/DK03/00011 (WO 03/058067), as well as a Declaration and Assignment for signature, asking him to review the application and then sign and return the Declaration and Assignment by March 7, 2005. No reply was received.

6. Copies of my letters of February 2 and 21, 2005 and associated enclosures (with copy of envelope cover) are attached, together with translations of my cover letters.

I furthermore declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are

punishable by fine or imprisonment or both under Section 1001 of Title 18
f the United States Code and that such willful false statements may
jeopardize the validity of the application or any patent issuing thereon.

By:


Mikael T. ChristensenDate: Apr. 6, 2005

Rec'd PCT/PTO 11 APR 2005

Steen B. Rasmussen
Boks 21
3540 Lyngø

Anbefalet

Hellerup, den 2. februar 2005

Vedr.: Dokumenter til brug i forb. med patentansøgning

Kære Steen,

Jeg vedlægger to dokumenter til brug ved indførelse af International patentansøgning WO 03/058067 i USA. Jeg har vedlagt kopi af den offentliggjorte ansøgning.

Da du er nævnt som opfinder vil jeg bede dig underskrive vedlagte "Combined Declaration and Power of Attorney" og "Assignment of Patent Application" og returnere disse i vedlagte svarkuvert til mig senest den 16. februar, 2005.

Hvis du har spørgsmål i denne forbindelse er du naturligvis velkommen til at kontakte mig.

Med venlig hilsen,

Oticon A/S



Mikael T. Christensen

English translation of Danish letter to Steen B. Rasmussen

Steen B. Rasmussen
Boks 21
3540 Lyngø

Registered post

Hellerup, 2 February 2005

Re.: Documents for use in connection with patent application

Dear Steen,

I enclose two documents for use in connection with entering of our International patent application WO 03/058067 into the USA. I have enclosed a copy of the published application.

Since you are mentioned as inventor, I hereby ask you please to sign the enclosed "Combined Declaration and Power of Attorney" and "Assignment of Patent Application" and return these in the enclosed stamped and addressed envelope, no later than 16 February, 2005.

If you have questions in this matter, please do not hesitate to contact me.

Best regards,
Oticon A/S

Mikael T. Christensen

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP

the specification of which (check one): ☐ is attached hereto.

☐ was filed on _____ as Application Serial No. _____ and was amended on _____.

☒ was filed as PCT international application no. PCT/DK03/00011, filed 9 JANUARY 2003 and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I do not know and do not believe the claimed invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application.

I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

<u>PA 2002 00038</u> (Number)	<u>DENMARK</u> (Country)	<u>10 JANUARY 2002</u> Day/Month/Year Filed	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
_____ (Number)	_____ (Country)	_____ Day/Month/Year Filed	<input type="checkbox"/> Yes	<input type="checkbox"/> No
_____ (Number)	_____ (Country)	_____ Day/Month/Year Filed	<input type="checkbox"/> Yes	<input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, §119 (e) of any United States provisional application(s) listed below:

<u>Application No.</u>	<u>Day/Month/Year Filed</u>	<u>Application No.</u>	<u>Day/Month/Year Filed</u>
------------------------	-----------------------------	------------------------	-----------------------------

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No._____
Filing Date_____
Status (patented, pending, abandoned)_____
Application Serial No._____
Filing Date_____
Status (patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Lawrence R. Radanovic, Reg. No. 23,077; Richard H. Tushin, Reg. No. 27,297; Donald N. Huff, Reg. No. 27,561; John P. DeLuca, Reg. No. 25,505; Charles Rutherford, Reg. No. 18,933; Robert L. Kelly, Reg. No. 31,843; Ernest E. Helms, Reg. No. 29,721; William F. Kolakowski, Reg. No. 41,908; John W. Rees, Reg. No. 38,278; and Adam B. Strauss, Reg. No. 43,167; all of Dykema Gossett PLLC. Direct all telephone calls to telephone no. (202) 906-8600 and faxes to (202) 906-8669.

Address all correspondence to **Dykema Gossett PLLC, Suite 300 West, 1300 I Street, N.W., Washington, D.C. 20005-3306.**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First Joint Inventor	Inventor's Signature	Date
Steen Brabrand RASMUSSEN		
Residence:	Citizenship	
Birkholmvej 1, DK-3540, Lyngbe, DENMARK	Danish	
Post Office Address:		
Same as above		

DC01\81520.1
ID\RHT

ASSIGNMENT OF PATENT APPLICATION

WHEREAS I, Steen Brabrand RASMUSSEN, of Birkholmvej 1, DK-3540 Lynge, DENMARK, have made a certain new and useful invention as set forth in an application for United States Letters Patent for an invention entitled PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP, filed 9 JANUARY 2003, serial number PCT/DK03/00011;

AND WHEREAS OTICON A/S, of Strandvejen 58, DK-2900 Hellerup, DENMARK, is desirous of acquiring the entire right, title and interest in and to said invention and in and to any and all Letters Patent of the United States which may be obtained therefor;

NOW, THEREFORE, for \$10.00 and other good and valuable consideration in hand, receipt of which is hereby acknowledged, I do hereby sell, assign, transfer and set over unto OTICON A/S, its legal representatives, successors, and assigns, the entire right, title and interest in and to said invention as set forth in the above-identified application, and in and to any and all patents of the United States which may be issued for said invention;

I request the Commissioner of Patents and Trademarks to issue any Letters Patent of the United States which may be issued for said invention to said OTICON A/S, its legal representatives, successors or assigns, as the sole owner of the entire right, title and interest in and to said patent and the invention covered thereby;

I hereby covenant that I have full right to convey the entire interest herein assigned and have not executed, and will not execute, any agreement in conflict herewith, and I also agree to execute all papers in connection with the application and any continuing or divisional applications thereof and in connection with any

SOLE

Atty Dkt. 66722-057-7

interference which may be declared involving this application or any continuing or divisional application thereof;

AND I hereby grant the firm of DYKEMA GOSSETT PLLC the power to insert on this Assignment any further identification which may be necessary or desirable to comply with the rules of the United States Patent and Trademark Office for recordation of this Assignment.

Date:

Name: **Steen Brabrand RASMUSSEN**

WITNESS:

(1) _____

Date:

DC01\81521.1
ID\RHT

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 July 2003 (17.07.2003)

PCT

(10) International Publication Number
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PA 2002 00038 10 January 2002 (10.01.2002) DK

(71) Applicant (for all designated States except US): INTER-
ACOUSTICS A/S [DK/DK]; Drejervænget 8, DK-Assens
(DK).

(72) Inventor; and

(75) Inventor/Applicant (for US only): RASMUSSEN, Steen,
Barbrand [DK/DK]; Birkeholmvej 1, DK-3540 Lyngø
(DK).

(74) Agent: CHRISTENSEN, Mikael, T.; Oticon A/S, Strand-
vejen 58, DK-2900 Hellerup (DK).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,
SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN,
YU, ZA, ZM, ZW.

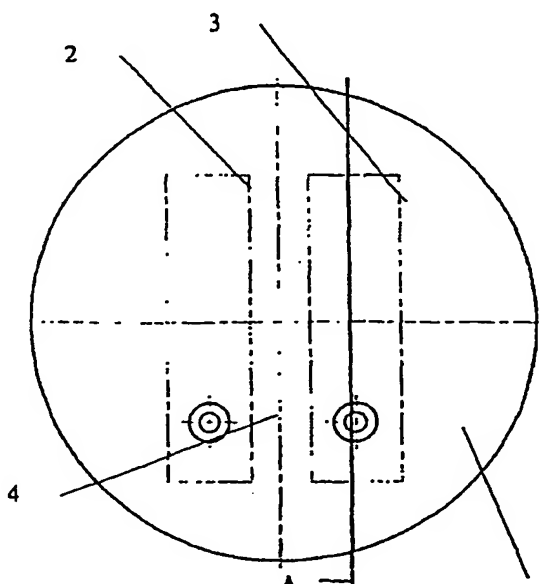
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European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI,
SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN,
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Published:

- with international search report
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP



(57) Abstract: The invention relates to a measuring device for
measuring in an ear canal, the device comprising a probe for
insertion into an ear canal and having an opening for letting air in
to and out of the ear canal the device further comprising a pump for
providing a pressure above a surrounding atmospheric pressure or
below the surrounding atmospheric pressure, the pump comprising
a housing with openings for inlet and/or outlet, where within
the housing a piston element having piezo electric properties is
disposed, where one opening in the pump is operatively connected
to the opening in the probe.

WO 03/058067 A1

TITLE

Piezo electric pump and device with such pump

5

AREA OF THE INVENTION

The invention relates to pumps incorporating piezo electric pump element. The invention further relates to a device implementing a pump using the principles of the pump element having piezo electric properties for generating pressure differences.

10

BACKGROUND OF THE INVENTION

In audiological equipment a pump is in most cases provided for establishing a pressure difference in the ear canal in relation to the existing atmospheric pressure. This comprises both pressure levels above and below the existing atmospheric pressure. Such pressure difference is e.g. created in connection with acoustic measurement in the ear canal in order to determine whether fluid is present in the middle ear, e.g. in connection with Otitis Media (middle ear inflammation).

20 The audiological equipment commercially available all suffer from the drawback that the pump types used in these are both bulky and in long-term use also unreliable. The size issue leads to instruments that are difficult to handle and the reliability issue leads to mechanical failure and malfunction with unnecessary repair and maintenance costs as well as patient re-examinations as the consequence.

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There is for these reasons a need for improvement in the audiological equipment and the pumps finding use in this equipment.

30 A first objective of the present invention is to provide a measuring device for measurement in the ear canal, which has a more reliable function, especially in long-term use.

A second objective is to provide a pump, which is suitable for use in a measuring device for measurement in the ear canal.

SUMMARY OF THE INVENTION

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According to the invention the first objective is achieved by means of a measuring device as defined in claim 1.

10

The invention will provide a device with a more reliable function and hence reduce the before mentioned drawbacks significantly.

15

In a preferred embodiment valve elements are provided in connection to the inlet opening and the outlet opening for controlling the inlet and the outlet and where the valve elements have piezo electric properties. This enable the pump to operate at relatively high frequency rates compared to conventional valves.

20

In a further preferred embodiment the pump is adapted to operate at a frequency above 18 kHz, preferably above 20 kHz. Hereby the operation can take place at a frequency above the normal audible frequency range and hence a more comfortable test may be carried out.

25

In order to provide an increased safety a pressure operated passive valve element may be provided in connection with the pressurized parts of the device. It is obvious that a too high or too low pressure may have a damaging effect on the patients tympanic membrane and hence may cause hearing damage. The independent safety valve is therefore highly desired and in most cases a required element.

30

According to the invention the second objective is achieved by means of a pump as defined in claim 6.

This aspect of the invention will provide a pump with a more reliable function and hence reduce the before mentioned drawbacks significantly in connection with a device according to the invention and further provide similar advantages in other applications.

By incorporating the valve elements as defined the pump will have the ability of operating at significantly higher frequencies than such pumps normally are capable of doing. This means that a number of applications are in reach, which hitherto have not been accessible.

The pump may in a preferred embodiment be adapted to operate at a frequency above 18 kHz, preferably above 20 kHz

10

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 FIG. 1 is a schematic drawing showing the pump according to the invention in a top view;
FIG. 2 is a schematic drawing showing the pump in FIG. 1 in a side view;
FIG. 3 is a schematic drawing showing the pump in FIG. 1 in a sectional view along the line A in FIG. 1
20 FIG. 4 is a schematic drawing showing a device according to the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

- Referring to FIG. 1 the pump according to the invention comprises a housing 7, 8 with opening 4 and opening 5. Valve elements 2,3 are indicated as located within the housing and intended for opening and closing the opening 4 and the opening 5, respectively.

From FIG. 2 it appears that the openings 4 and 5 in the housing 7,8 are running through a pipe stub extending from the housing. This facilitates the connection of necessary tube elements.

30

From FIG. 3 the inner cavity of the pump housing 7,8 appears. The two housing parts 7,8 are sealed along the circumferential edge. In the top part 8 an opening 5 pipe stub is

located. On the side facing the housing inner cavity in the assembled state the two valve elements 2,3 are fastened. The valves can in principle be provided at any location, e.g. on the outside of the housing or within the passage where the opening and closing that need to be controlled. The valve elements each consist of a piezo electric element.

5

Each valve element is fastened at a location in a distance from the openings 4 and 5 in such a manner that the valve is closing an opening in one state of electrical influence, e.g. zero influence, and opening the same in another state of electrical influence. The valve is hereby of a type having piezo electrical properties that provide a bending of the valve element upon applying a certain electrical influence to it. In general the valve could have piezo electrical properties that provide any change in the physical dimensions, i.e. a bending of the valve element upon applying a certain electrical influence to it is one preferred embodiment. In the lower housing part 7 one or a series of piezo electrical elements are located in a stacked configuration so as to provide a piston element in the pump housing. Between the piston element and the inner sides of the housing element 7 an elastic yielding sealing is provided. This sealing may be a rubber O-ring or a silicone material or a similar substance.

10

15

From FIG. 4 an audiological device incorporating a pump according to the invention is shown schematically. The device comprises a probe element adapted to be inserted into an ear canal of a person to be examined. A tubular element is at first end connected to a corresponding opening in the probe element and at second end opposite the first end connected to the opening 5, of the pump. A tubular element is at first end connected to the opening 5 of the pump housing by means of a T-shaped connecting branch and at second end connected to pressure transducer. The said pressure transducer provides an electrical signal for control electronics for the control of the pressure in the ear canal. Further tubular elements connects the outlet openings of sound output transducers to openings in the probe element and the inlet opening of a input transducer to an opening in the probe element. The output transducers are controlled by control electronics and the input transducer signal is delivered to a signal processor for further processing. In connection with the control electronics and the signal processor a control panel as well as output means, e.g. a display, are provided. The control electronics controls the opening and closing of the valve elements in relation to the piston movement in a manner that

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enables the creation of pressures above as well as below the surrounding atmospheric pressure. The piston movement is hereby also controlled by the control electronics. The different modes of operation where the pressures above and below the surrounding pressure are created may be part of an automated test procedure.

5

The operation of the pump in a situation where a pressure above the surrounding pressure is supplied to the ear canal takes place in the following manner.

- 1) The probe with the pressure tube from the pump is inserted into the ear canal.
- 2) The valve 5 is closed
- 10 3) The valve 4 is opened
- 4) The piston height is reduced by non- supply of electrical power
- 5) Air is drawn into the pump housing through valve 4
- 6) Valve 4 is closed
- 7) Valve 5 is opened
- 15 8) The piston height is increase by supply of electrical power and the air is supplied to the pressure tube
- 9) Repeating the steps 2-8 with the piston frequency selected

20 The operation of the pump in a situation where a pressure below the surrounding pressure is supplied to the ear canal takes place in the following manner.

- 1) The probe with the pressure tube from the pump is inserted into the ear canal.
- 2) The valve 4 is closed
- 3) The valve 5 is opened
- 25 4) The piston height is reduced by non- supply of electrical power
- 5) Air is drawn into the pump housing through valve 5
- 6) Valve 5 is closed
- 7) Valve 4 is opened
- 8) The piston height is increase by supply of electrical power and the air is exited to the
- 30 surroundings
- 9) Repeating the steps 2-8 with the piston frequency selected

Such devices are used for providing audiological tests. One example of such test is the recording of a tympanogram. This test serves its purpose in evaluation of conductive hearing loss and assessment of middle ear function. After a number of initial procedures comprising instructing the patient and initializing the equipment the test procedure may
5 be started. The probe is inserted in the ear canal to be tested. The probe should have an airtight sealing. During the test procedure the pressure is swept from a desired maximum pressure level to a desired minimum pressure level. During this pressure sweep the equipment generates a sound or tone signal through an output transducer, where this signal is reflected by the tympanic membrane and the reflected signal can be
10 obtained by the input transducer adapted for this purpose. The values recorded may be displayed in a X-Y diagram.

CLAIMS

1. A measuring device for acoustic measurement in an ear canal, the device comprising a probe for insertion into an ear canal in a sealing manner and having
5 an opening for transport of air into or out of the ear canal, the device further comprising a pump for providing a pressure difference in relation to a surrounding atmospheric pressure, the pump comprising a housing with openings for inlet and/or outlet, where within the housing a piston element having piezo electric properties is disposed, where one opening in the pump is operatively
10 connected to the opening in the probe.
2. A measuring device according to claim 1, where in connection with the inlet opening and the outlet opening valve elements are provided for controlling the inlet and the outlet and where the valve elements have piezo electric properties.
15
3. A measuring device according to claim 1 or 2, where the pump is adapted to operate at a frequency above 18 kHz, preferably above 20 kHz.
4. A measuring device according to claim 1, 2 or 3, where control electronics are
20 provided for controlling valve positions in relation to the piston movement in such a manner that in one mode of operation a pressure above the surrounding pressure may be obtained and in another mode of operation a pressure below the surrounding pressure may be obtained.
- 25 5. A measuring device according to any of the claims 1-4, where a pressure operated passive valve element is provided in connection with the pressurized parts of the device.
6. A pump having a housing with an inlet opening and an outlet opening and
30 disposed within the housing a piston element having piezo electric properties, where in connection the inlet opening and the outlet opening valve elements are provided for controlling the inlet and the outlet, where the valve elements are valve elements having piezo electric properties.

7. A pump according to claim 6, where the pump is adapted to operate at a frequency above 18 kHz, preferably above 20 kHz.

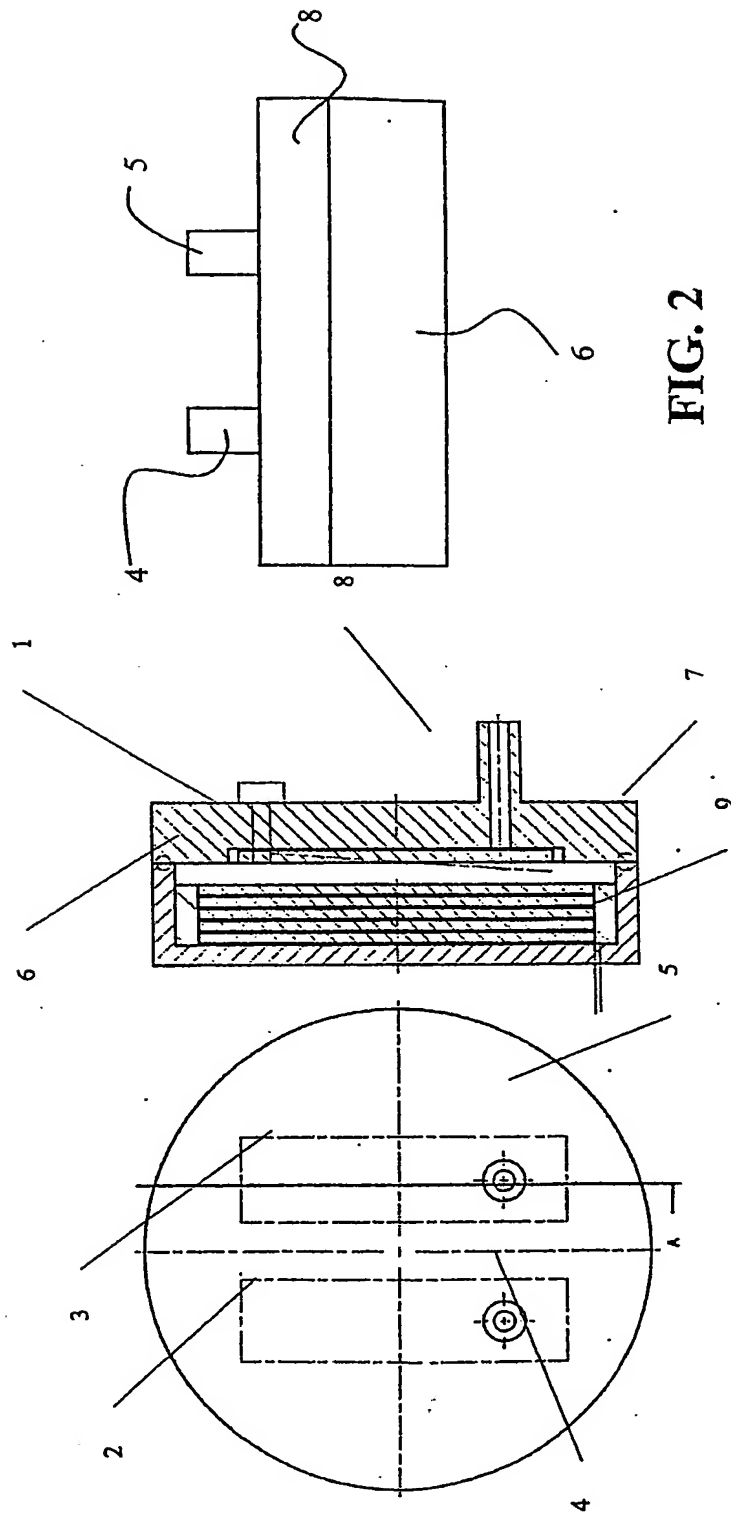
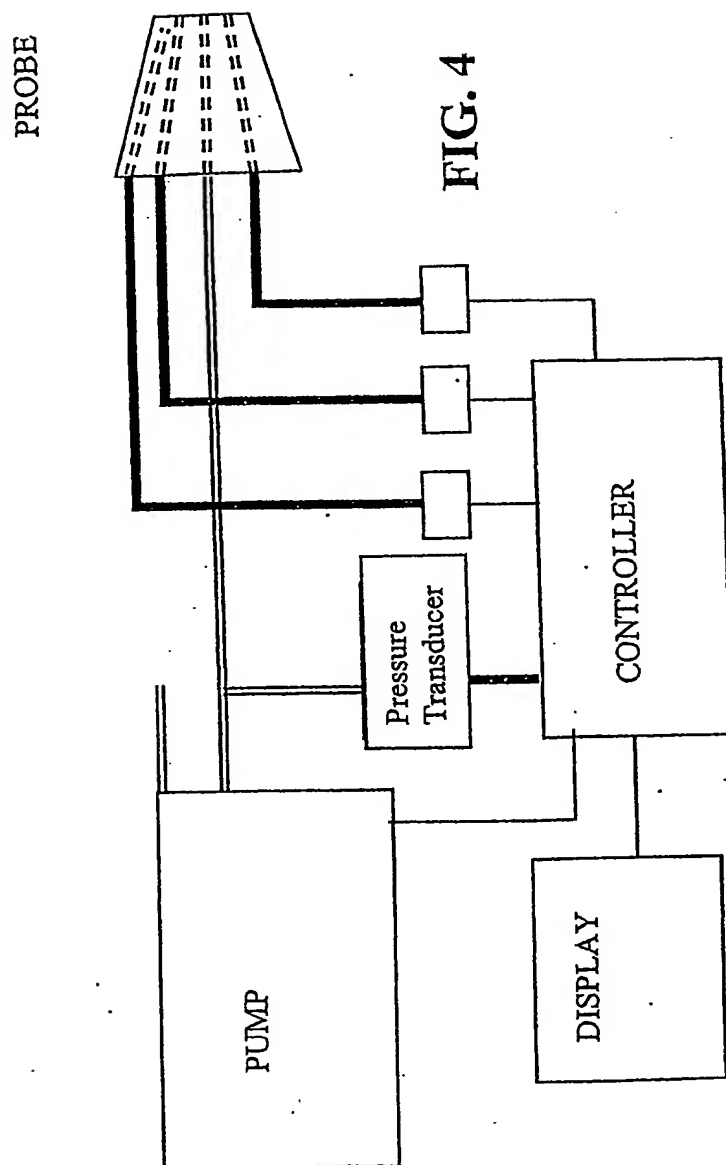


FIG. 2

FIG. 3

FIG. 1



A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 F04B17/00 A61B 12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 F04B A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 688 582 A (WILLIAMS DANIEL L ET AL) 25 August 1987 (1987-08-25) column 4, line 19 -column 5, line 42 abstract; figure 9	1-5
A	US 4 237 905 A (KELLER JAMES E ET AL) 9 December 1980 (1980-12-09) column 6, line 8 -column 7, line 12	1-5
A	US 6 071 088 A (FACE SAMUEL A ET AL) 6 June 2000 (2000-06-06) column 9, line 7 - line 46 column 15, line 3 - line 20; figure 7	1-5
X	---	6,7
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

30 April 2003

Date of mailing of the international search report

27. 05. 2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

ULRIKA WESTMAN/JA A

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 798 600 A (SAGER FRANK EVERETT ET AL) 25 August 1998 (1998-08-25) column 8, line 38 - line 56; figure 7	1-5
X	---	6,7
A	US 6 164 933 A (MASAKI YASUFUMI ET AL) 26 December 2000 (2000-12-26) column 8, line 20 - line 38 abstract; figure 15 -----	1-7

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4688582	A	25-08-1987	NONE
US 4237905	A	09-12-1980	CA 1136751 A1 30-11-1982 DK 325880 A 01-02-1981 GB 2060881 A ,B 07-05-1981 IT 1143097 B 22-10-1986 JP 56028741 A 20-03-1981
US 6071088	A	06-06-2000	US 5816780 A 06-10-1998 US 6042345 A 28-03-2000 US 6074178 A 13-06-2000
US 5798600	A	25-08-1998	US 5761782 A 09-06-1998 US 5892314 A 06-04-1999 US 5889354 A 30-03-1999
US 6164933	A	26-12-2000	JP 11311184 A 09-11-1999 JP 2000171320 A 23-06-2000 DE 19918694 A1 04-11-1999 DE 29924151 U1 11-04-2002



oticon
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2900 Hellerup

Attn.: Mikael T. Christensen

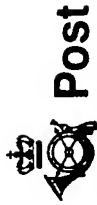
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ANBEFALET

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Udfyldes af afsenderen

Modtagers navn og adresse			
DGM / Att.: Bent Buus			
Kollegievej 6			
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<input checked="" type="checkbox"/> Brev	<input type="checkbox"/> Pakke	<input type="checkbox"/> Forsigtig	<input type="checkbox"/> Ekspres
			<input checked="" type="checkbox"/> Rekommanderet
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Susanne Lohse Pedersen			
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050202			

Postkvittering

Udfyldes af postvæsenet

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15 DEC 2004 2800 Lyngby, Afg. værdi	
Vægt	Reg.nr.
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	657

Steen B. Rasmussen
Boks 21
3540 Lyngø

Anbefalet

Hellerup, den 21. februar 2005

Vedr.: Dokumenter til brug i forb. med patentansøgning

Kære Steen,

Da du endnu ikke har reageret på min allerede fremsendte forespørgsel af 2. februar 2005 (kopi vedlagt), fremsender jeg hermed igen vedlagt to dokumenter til brug ved indførelse af International patentansøgning WO 03/058067 i USA. Jeg vedlægger endvidere en kopi af den offentliggjorte ansøgning.

Da du er nævnt som opfinder vil jeg bede dig underskrive vedlagte "Combined Declaration and Power of Attorney" og "Assignment of Patent Application" og returnere disse i vedlagte svarkuvert til mig senest den 7. marts 2005.

Hvis du har spørgsmål i denne forbindelse er du naturligvis velkommen til at kontakte mig.

Med venlig hilsen,

Oticon A/S



Mikael T. Christensen

English translation of Danish letter to Steen B. Rasmussen

Steen B. Rasmussen
Boks 21
3540 Lynge

Registered post

Hellerup, 21 February 2005

Re.: Documents for use in connection with patent application

Dear Steen,

As you still haven't responded to my already forwarded enquiry of 2 February 2005 (copy enclosed), I hereby again enclosed forward two documents for use in connection with entering of our International patent application WO 03/058067 into the USA. I have enclosed a copy of the published application.

Since you are mentioned as inventor, I hereby ask you please to sign the enclosed "Combined Declaration and Power of Attorney" and "Assignment of Patent Application" and return these in the enclosed stamped and addressed envelope, no later than 7 March, 2005.

If you have questions in this matter, please do not hesitate to contact me.

Best regards,
Oticon A/S

Mikael T. Christensen

Steen B. Rasmussen
Boks 21
3540 Lyngø

Anbefalet

Hellerup, den 2. februar 2005

Vedr.: Dokumenter til brug i forb. med patentansøgning

Kære Steen,

Jeg vedlægger to dokumenter til brug ved indførelse af International patentansøgning WO 03/058067 i USA. Jeg har vedlagt kopi af den offentliggjorte ansøgning.

Da du er nævnt som opfinder vil jeg bede dig underskrive vedlagte "Combined Declaration and Power of Attorney" og "Assignment of Patent Application" og returnere disse i vedlagte svarkuvert til mig senest den 16. februar, 2005.

Hvis du har spørgsmål i denne forbindelse er du naturligvis velkommen til at kontakte mig.

Med venlig hilsen,
Oticon A/S


Mikael T. Christensen

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR UTILITY PATENT APPLICATION (Includes PCT)

Attorney Docket No.
66722-057-7

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP

the specification of which (check one): ☐ is attached hereto.

☐ was filed on _____ as Application Serial No. _____ and was amended on _____.

☒ was filed as PCT international application no. PCT/DK03/00011, filed 9 JANUARY 2003 and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I do not know and do not believe the claimed invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application.

I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

<u>PA 2002 00038</u>	<u>DENMARK</u>	<u>10 JANUARY 2002</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	Yes	No
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	Yes	No
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	Yes	No

I hereby claim the benefit under Title 35, United States Code, §119 (e) of any United States provisional application(s) listed below:

Application No.	Day/Month/Year Filed	Application No.	Day/Month/Year Filed
-----------------	----------------------	-----------------	----------------------

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.

Filing Date

Status (patented, pending, abandoned)

Application Serial No.

Filing Date

Status (patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Lawrence R. Radanovic, Reg. No. 23,077; Richard H. Tushin, Reg. No. 27,297; Donald N. Huff, Reg. No. 27,561; John P. DeLuca, Reg. No. 25,505; Charles Rutherford, Reg. No. 18,933; Robert L. Kelly, Reg. No. 31,843; Ernest E. Helms, Reg. No. 29,721; William F. Kolakowski, Reg. No. 41,908; John W. Rees, Reg. No. 38,278; and Adam B. Strauss, Reg. No. 43,167; all of Dykema Gossett PLLC. Direct all telephone calls to telephone no. (202) 906-8600 and faxes to (202) 906-8669.

Address all correspondence to **Dykema Gossett PLLC, Suite 300 West, 1300 I Street, N.W., Washington, D.C. 20005-3306.**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First Joint Inventor	Inventor's Signature	Date
Steen Brabrand RASMUSSEN		
Residence:	Citizenship	
Birkholmvej 1, DK-3540, Lynge, DENMARK	Danish	
Post Office Address:		
Same as above		

DC01\81520.1
ID\RHT

ASSIGNMENT OF PATENT APPLICATION

WHEREAS I, Steen Brabrand RASMUSSEN, of Birkholmvej 1, DK-3540 Lynge, DENMARK, have made a certain new and useful invention as set forth in an application for United States Letters Patent for an invention entitled PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP, filed 9 JANUARY 2003, serial number PCT/DK03/00011;

AND WHEREAS OTICON A/S, of Strandvejen 58, DK-2900 Hellerup, DENMARK, is desirous of acquiring the entire right, title and interest in and to said invention and in and to any and all Letters Patent of the United States which may be obtained therefor;

NOW, THEREFORE, for \$10.00 and other good and valuable consideration in hand, receipt of which is hereby acknowledged, I do hereby sell, assign, transfer and set over unto OTICON A/S, its legal representatives, successors, and assigns, the entire right, title and interest in and to said invention as set forth in the above-identified application, and in and to any and all patents of the United States which may be issued for said invention;

I request the Commissioner of Patents and Trademarks to issue any Letters Patent of the United States which may be issued for said invention to said OTICON A/S, its legal representatives, successors or assigns, as the sole owner of the entire right, title and interest in and to said patent and the invention covered thereby;

I hereby covenant that I have full right to convey the entire interest herein assigned and have not executed, and will not execute, any agreement in conflict herewith, and I also agree to execute all papers in connection with the application and any continuing or divisional applications thereof and in connection with any

SOLE

Atty. 66722-057-7

interference which may be declared involving this application or any continuing or divisional application thereof;

AND I hereby grant the firm of DYKEMA GOSSETT PLLC the power to insert on this Assignment any further identification which may be necessary or desirable to comply with the rules of the United States Patent and Trademark Office for recordation of this Assignment.

Date:

Name: **Steen Brabrand RASMUSSEN**

WITNESS:

(1) _____

Date:

DC01\81521.1
ID\RH

(19) World Intellectual Property Organization
International Bureau



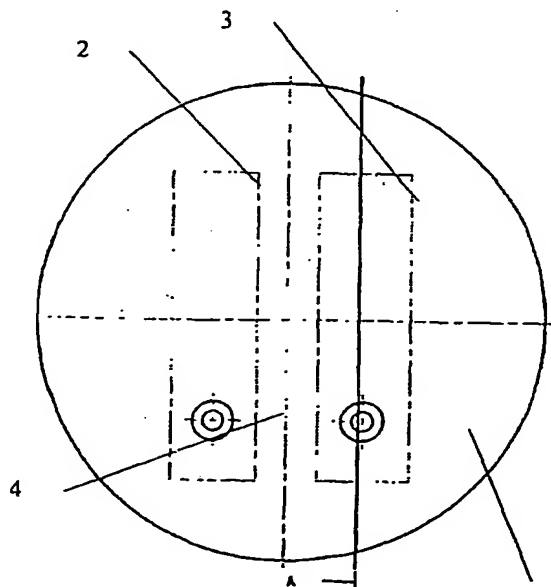
(43) International Publication Date
17 July 2003 (17.07.2003)

PCT

(10) International Publication Number
WO 03/058067 A1

- (51) International Patent Classification⁷: **F04B 17/00**, A61B 5/12
- (21) International Application Number: PCT/DK03/00011
- (22) International Filing Date: 9 January 2003 (09.01.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
PA 2002 00038 10 January 2002 (10.01.2002) DK
- (71) Applicant (*for all designated States except US*): INTER-ACOUSTICS A/S [DK/DK]; Drejervænget 8, DK-Assens (DK).
- (72) Inventor; and
- (75) Inventor/Applicant (*for US only*): RASMUSSEN, Steen, Barbrand [DK/DK]; Birkeholmvej 1, DK-3540 Lynge (DK).
- (74) Agent: CHRISTENSEN, Mikael, T.; Oticon A/S, Strandvejen 58, DK-2900 Hellerup (DK).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
- with international search report
 - before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP



(57) Abstract: The invention relates to a measuring device for measuring in an ear canal, the device comprising a probe for insertion into an ear canal and having an opening for letting air in to and out of the ear canal the device further comprising a pump for providing a pressure above a surrounding atmospheric pressure or below the surrounding atmospheric pressure, the pump comprising a housing with openings for inlet and/or outlet, where within the housing a piston element having piezo electric properties is disposed, where one opening in the pump is operatively connected to the opening in the probe.

WO 03/058067 A1

TITLE

Piezo electric pump and device with such pump

5 AREA OF THE INVENTION

The invention relates to pumps incorporating piezo electric pump element. The invention further relates to a device implementing a pump using the principles of the pump element having piezo electric properties for generating pressure differences.

10 BACKGROUND OF THE INVENTION

In audiological equipment a pump is in most cases provided for establishing a pressure difference in the ear canal in relation to the existing atmospheric pressure. This comprises both pressure levels above and below the existing atmospheric pressure. Such pressure difference is e.g. created in connection with acoustic measurement in the ear canal in order to determine whether fluid is present in the middle ear, e.g. in connection with Otitis Media (middle ear inflammation).

20 The audiological equipment commercially available all suffer from the drawback that the pump types used in these are both bulky and in long-term use also unreliable. The size issue leads to instruments that are difficult to handle and the reliability issue leads to mechanical failure and malfunction with unnecessary repair and maintenance costs as well as patient re-examinations as the consequence.

25 There is for these reasons a need for improvement in the audiological equipment and the pumps finding use in this equipment.

30 A first objective of the present invention is to provide a measuring device for measurement in the ear canal, which has a more reliable function, especially in long-term use.

A second objective is to provide a pump, which is suitable for use in a measuring device for measurement in the ear canal.

SUMMARY OF THE INVENTION

5 According to the invention the first objective is achieved by means of a measuring device as defined in claim 1.

10 The invention will provide a device with a more reliable function and hence reduce the before mentioned drawbacks significantly.

15 In a preferred embodiment valve elements are provided in connection to the inlet opening and the outlet opening for controlling the inlet and the outlet and where the valve elements have piezo electric properties. This enable the pump to operate at relatively high frequency rates compared to conventional valves.

20 In a further preferred embodiment the pump is adapted to operate at a frequency above 18 kHz, preferably above 20 kHz. Hereby the operation can take place at a frequency above the normal audible frequency range and hence a more comfortable test may be carried out.

25 In order to provide an increased safety a pressure operated passive valve element may be provided in connection with the pressurized parts of the device. It is obvious that a too high or too low pressure may have a damaging effect on the patients tympanic membrane and hence may cause hearing damage. The independent safety valve is therefore highly desired and in most cases a required element.

30 According to the invention the second objective is achieved by means of a pump as defined in claim 6.

This aspect of the invention will provide a pump with a more reliable function and hence reduce the before mentioned drawbacks significantly in connection with a device according to the invention and further provide similar advantages in other applications.

By incorporating the valve elements as defined the pump will have the ability of operating at significantly higher frequencies than such pumps normally are capable of doing. This means that a number of applications are in reach, which hitherto have not been accessible.

The pump may in a preferred embodiment be adapted to operate at a frequency above 18 kHz, preferably above 20 kHz

10

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 FIG. 1 is a schematic drawing showing the pump according to the invention in a top view;
FIG. 2 is a schematic drawing showing the pump in FIG. 1 in a side view;
FIG. 3 is a schematic drawing showing the pump in FIG. 1 in a sectional view along the line A in FIG. 1
20 FIG. 4 is a schematic drawing showing a device according to the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1 the pump according to the invention comprises a housing 7, 8 with opening 4 and opening 5. Valve elements 2,3 are indicated as located within the housing and intended for opening and closing the opening 4 and the opening 5, respectively.

From FIG. 2 it appears that the openings 4 and 5 in the housing 7,8 are running through a pipe stub extending from the housing. This facilitates the connection of necessary tube elements.

30

From FIG. 3 the inner cavity of the pump housing 7,8 appears. The two housing parts 7,8 are sealed along the circumferential edge. In the top part 8 an opening 5 pipe stub is

located. On the side facing the housing inner cavity in the assembled state the two valve elements 2,3 are fastened. The valves can in principle be provided at any location, e.g. on the outside of the housing or within the passage where the opening and closing that need to be controlled. The valve elements each consist of a piezo electric element.

5

Each valve element is fastened at a location in a distance from the openings 4 and 5 in such a manner that the valve is closing an opening in one state of electrical influence, e.g. zero influence, and opening the same in another state of electrical influence. The valve is hereby of a type having piezo electrical properties that provide a bending of the valve element upon applying a certain electrical influence to it. In general the valve could have piezo electrical properties that provide any change in the physical dimensions, i.e. a bending of the valve element upon applying a certain electrical influence to it is one preferred embodiment. In the lower housing part 7 one or a series of piezo electrical elements are located in a stacked configuration so as to provide a piston element in the pump housing. Between the piston element and the inner sides of the housing element 7 an elastic yielding sealing is provided. This sealing may be a rubber O-ring or a silicone material or a similar substance.

From FIG. 4 an audiological device incorporating a pump according to the invention is shown schematically. The device comprises a probe element adapted to be inserted into an ear canal of a person to be examined. A tubular element is at first end connected to a corresponding opening in the probe element and at second end opposite the first end connected to the opening 5, of the pump. A tubular element is at first end connected to the opening 5 of the pump housing by means of a T-shaped connecting branch and at second end connected to pressure transducer. The said pressure transducer provides an electrical signal for control electronics for the control of the pressure in the ear canal. Further tubular elements connects the outlet openings of sound output transducers to openings in the probe element and the inlet opening of a input transducer to an opening in the probe element. The output transducers are controlled by control electronics and the input transducer signal is delivered to a signal processor for further processing. In connection with the control electronics and the signal processor a control panel as well as output means, e.g. a display, are provided. The control electronics controls the opening and closing of the valve elements in relation to the piston movement in a manner that

enables the creation of pressures above as well as below the surrounding atmospheric pressure. The piston movement is hereby also controlled by the control electronics. The different modes of operation where the pressures above and below the surrounding pressure are created may be part of an automated test procedure.

5

The operation of the pump in a situation where a pressure above the surrounding pressure is supplied to the ear canal takes place in the following manner.

- 1) The probe with the pressure tube from the pump is inserted into the ear canal.
- 2) The valve 5 is closed
- 10 3) The valve 4 is opened
- 4) The piston height is reduced by non- supply of electrical power
- 5) Air is drawn into the pump housing through valve 4
- 6) Valve 4 is closed
- 7) Valve 5 is opened
- 15 8) The piston height is increase by supply of electrical power and the air is supplied to the pressure tube
- 9) Repeating the steps 2-8 with the piston frequency selected

20 The operation of the pump in a situation where a pressure below the surrounding pressure is supplied to the ear canal takes place in the following manner.

- 1) The probe with the pressure tube from the pump is inserted into the ear canal.
- 2) The valve 4 is closed
- 3) The valve 5 is opened
- 25 4) The piston height is reduced by non- supply of electrical power
- 5) Air is drawn into the pump housing through valve 5
- 6) Valve 5 is closed
- 7) Valve 4 is opened
- 8) The piston height is increase by supply of electrical power and the air is exited to the
- 30 surroundings
- 9) Repeating the steps 2-8 with the piston frequency selected

Such devices are used for providing audiological tests. One example of such test is the recording of a tympanogram. This test serves its purpose in evaluation of conductive hearing loss and assessment of middle ear function. After a number of initial procedures comprising instructing the patient and initializing the equipment the test procedure may
5 be started. The probe is inserted in the ear canal to be tested. The probe should have an airtight sealing. During the test procedure the pressure is swepted from a desired maximum pressure level to a desired minimum pressure level. During this pressure sweep the equipment generates a sound or tone signal through an output transducer, where this signal is reflected by the tympanic membrane and the reflected signal can be
10 obtained by the input transducer adapted for this purpose. The values recorded may be displayed in a X-Y diagram.

CLAIMS

1. A measuring device for acoustic measurement in an ear canal, the device comprising a probe for insertion into an ear canal in a sealing manner and having an opening for transport of air into or out of the ear canal, the device further comprising a pump for providing a pressure difference in relation to a surrounding atmospheric pressure, the pump comprising a housing with openings for inlet and/or outlet, where within the housing a piston element having piezo electric properties is disposed, where one opening in the pump is operatively connected to the opening in the probe.

5

10
2. A measuring device according to claim 1, where in connection with the inlet opening and the outlet opening valve elements are provided for controlling the inlet and the outlet and where the valve elements have piezo electric properties.

15
3. A measuring device according to claim 1 or 2, where the pump is adapted to operate at a frequency above 18 kHz, preferably above 20 kHz.
4. A measuring device according to claim 1, 2 or 3, where control electronics are provided for controlling valve positions in relation to the piston movement in such a manner that in one mode of operation a pressure above the surrounding pressure may be obtained and in another mode of operation a pressure below the surrounding pressure may be obtained.

20
5. A measuring device according to any of the claims 1-4, where a pressure operated passive valve element is provided in connection with the pressurized parts of the device.

25
6. A pump having a housing with an inlet opening and an outlet opening and disposed within the housing a piston element having piezo electric properties, where in connection the inlet opening and the outlet opening valve elements are provided for controlling the inlet and the outlet, where the valve elements are valve elements having piezo electric properties.

30

7. A pump according to claim 6, where the pump is adapted to operate at a frequency above 18 kHz, preferably above 20 kHz.

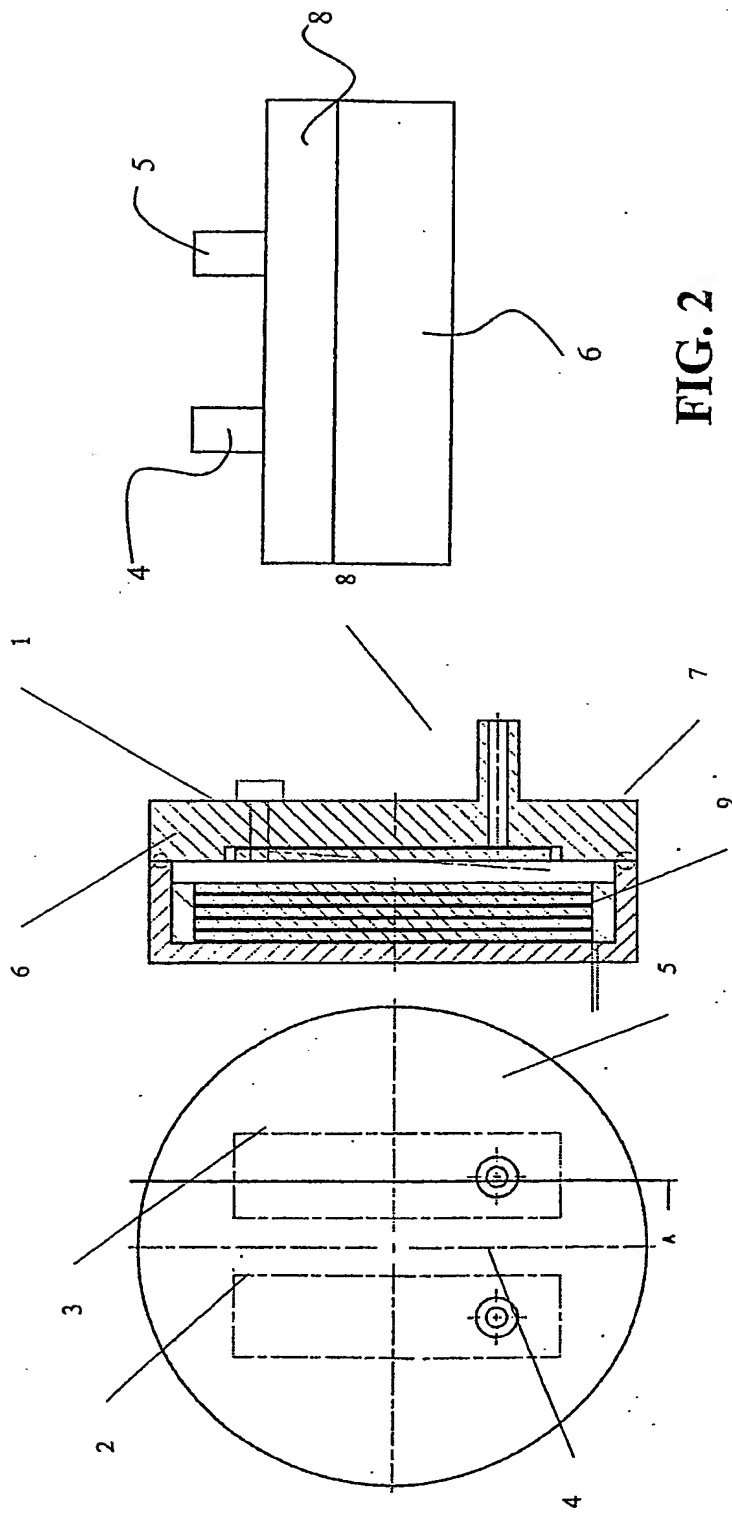
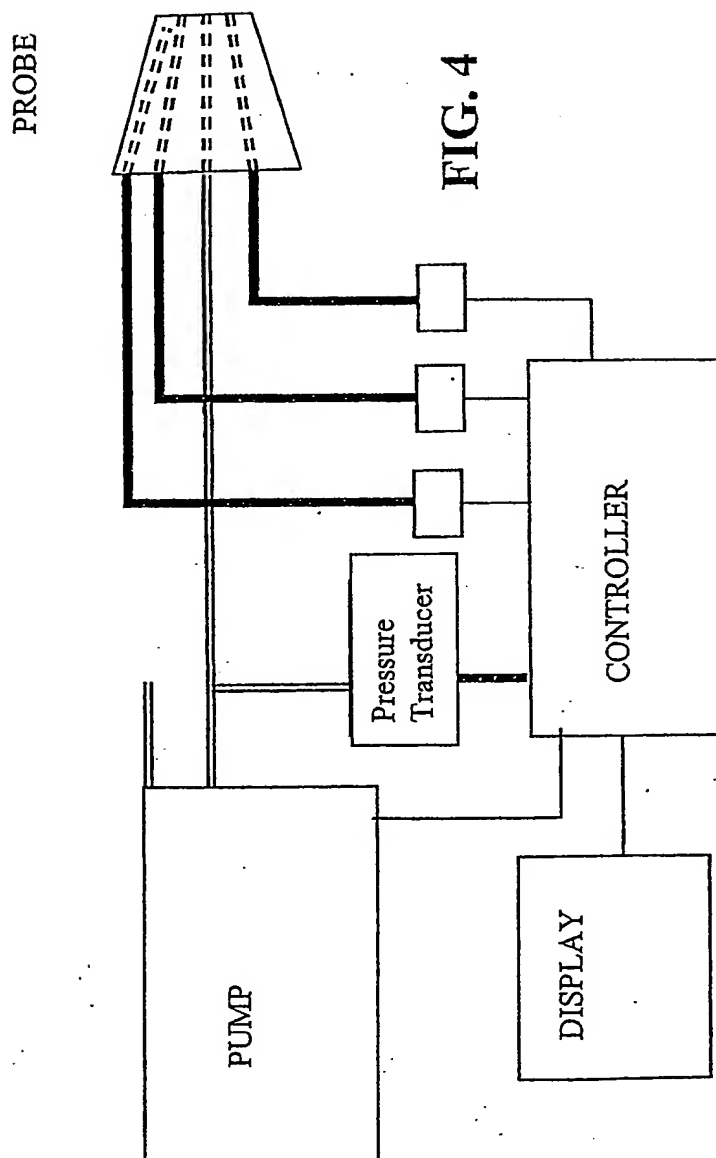


FIG. 1

FIG. 3

FIG. 2



INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/00011

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 F04B17/00 A61B5/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F04B A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 688 582 A (WILLIAMS DANIEL L ET AL) 25 August 1987 (1987-08-25) column 4, line 19 - column 5, line 42 abstract; figure 9	1-5
A	US 4 237 905 A (KELLER JAMES E ET AL) 9 December 1980 (1980-12-09) column 6, line 8 - column 7, line 12	1-5
A	US 6 071 088 A (FACE SAMUEL A ET AL) 6 June 2000 (2000-06-06) column 9, line 7 - line 46 column 15, line 3 - line 20; figure 7	1-5
X	---	6,7
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

30 April 2003

Date of mailing of the international search report

27.05.2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

ULRIKA WESTMAN/JA A

INTERNATIONAL SEARCH REPORT

International Application No

PCT/03/00011

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 798 600 A (SAGER FRANK EVERETT ET AL) 25 August 1998 (1998-08-25) column 8, line 38 - line 56; figure 7	1-5
X	---	6,7
A	US 6 164 933 A (MASAKI YASUFUMI ET AL) 26 December 2000 (2000-12-26) column 8, line 20 - line 38 abstract; figure 15 -----	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 93/00011

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4688582	A	25-08-1987	NONE	
US 4237905	A	09-12-1980	CA 1136751 A1 DK 325880 A GB 2060881 A ,B IT 1143097 B JP 56028741 A	30-11-1982 01-02-1981 07-05-1981 22-10-1986 20-03-1981
US 6071088	A	06-06-2000	US 5816780 A US 6042345 A US 6074178 A	06-10-1998 28-03-2000 13-06-2000
US 5798600	A	25-08-1998	US 5761782 A US 5892314 A US 5889354 A	09-06-1998 06-04-1999 30-03-1999
US 6164933	A	26-12-2000	JP 11311184 A JP 2000171320 A DE 19918694 A1 DE 29924151 U1	09-11-1999 23-06-2000 04-11-1999 11-04-2002



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To : Dykema Gossett PLLC

Fax no.: 1202906-8669

Att : _____

From: Steen B. Rasmussen Birkholmvej 1. DK- 3540 Lyngø

Phone: 48187282

Fax: 48187280

Mobil Phone: 40388888

E-mail: s@sbr.dk

Refuse to sign.

SOLE

Atty Dkt. 66722-057-7**ASSIGNMENT OF PATENT APPLICATION**

WHEREAS I, Steen Brabrand RASMUSSEN, of Birkholmvej 1, DK-3540 Lyngbe, DENMARK, have made a certain new and useful invention as set forth in an application for United States Letters Patent for an invention entitled PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP, filed 9 JANUARY 2003, serial number PCT/DK03/00011;

AND WHEREAS OTICON A/S, of Strandvejen 58, DK-2900 Hellerup, DENMARK, is desirous of acquiring the entire right, title and interest in and to said invention and in and to any and all Letters Patent of the United States which may be obtained therefor;

NOW, THEREFORE, for \$10.00 and other good and valuable consideration in hand, receipt of which is hereby acknowledged, I do hereby sell, assign, transfer and set over unto OTICON A/S, its legal representatives, successors, and assigns, the entire right, title and interest in and to said invention as set forth in the above-identified application, and in and to any and all patents of the United States which may be issued for said invention;

I request the Commissioner of Patents and Trademarks to issue any Letters Patent of the United States which may be issued for said invention to said OTICON A/S, its legal representatives, successors or assigns, as the sole owner of the entire right, title and interest in and to said patent and the invention covered thereby;

I hereby covenant that I have full right to convey the entire interest herein assigned and have not executed, and will not execute, any agreement in conflict herewith, and I also agree to execute all papers in connection with the application and any continuing or divisional applications thereof and in connection with any

SOLE**Atty Dkt. 66722-057-7**

interference which may be declared involving this application or any continuing or divisional application thereof;

AND I hereby grant the firm of DYKEMA GOSSETT PLLC the power to insert on this Assignment any further identification which may be necessary or desirable to comply with the rules of the United States Patent and Trademark Office for recordation of this Assignment.

Date:_____
Name: Steen Brabrand RASMUSSEN

WITNESS:

(1) _____

Date:DC01N81521.1
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For your information

Lynge 14/03 2005

On several occasions, the Danish company Oticon A/S, has made unsuccessful attempts to make me sign an Assignment of Patent Application, based on Danish patent application PA 2002 00038, January 10th PCT/DK03/00011 "Piezo Electric Pump and device with such pump" Atty Dkt. 66722-057-7.

Oticon A/S has made such attempts by several recommended letters with requests of transport of rights. I have answered all of these letters, but have denied signing any such requests. In my opinion, the legal conditions for such are non-existent, and I shall therefore inform that I reserve the right to take any necessary legal action against any persons/companies that will attempt in any illegal way to transport the rights of the above patent without my consent.

Sincerely Yours

Steen B. Rasmussen
Birkholmvej 1
DK-3540 Lynge
Denmark
e-mail: s@sbr.dk
Telefax 4548187280

**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR UTILITY PATENT APPLICATION (Includes PCT)**
**Attorney Docket No.
66722-057-7**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PIEZO ELECTRIC PUMP AND DEVICE WITH SUCH PUMP

the specification of which (check one): ☐ is attached hereto.

☐ was filed on _____ as Application Serial No. _____ and was amended on _____.

☒ was filed as PCT international application no. PCT/DK03/00011, filed 9 JANUARY 2003 and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I do not know and do not believe the claimed invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application.

I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed

<u>PA 2002 00038</u>	<u>DENMARK</u>	<u>10 JANUARY 2002</u>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	Yes	No
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	Yes	No
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	Day/Month/Year Filed	Yes	No

I hereby claim the benefit under Title 35, United States Code, §119 (e) of any United States provisional application(s) listed below:

<u>Application No.</u>	<u>Day/Month/Year Filed</u>	<u>Application No.</u>	<u>Day/Month/Year Filed</u>
------------------------	-----------------------------	------------------------	-----------------------------

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Attorney Dkt. No. 66722-057-7

Application Serial No.

Filing Date

Status (patented, pending, abandoned)

Application Serial No.

Filing Date

Status (patented, pending, abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Lawrence R. Radanovic, Reg. No. 23,077; Richard H. Tushin, Reg. No. 27,297; Donald N. Huff, Reg. No. 27,561; John P. DeLuca, Reg. No. 25,505; Charles Rutherford, Reg. No. 18,933; Robert L. Kelly, Reg. No. 31,843; Ernest E. Helms, Reg. No. 29,721; William F. Kolakowski, Reg. No. 41,908; John W. Rees, Reg. No. 38,278; and Adam B. Strauss, Reg. No. 43,167; all of Dykema Gossett PLLC. Direct all telephone calls to telephone no. (202) 906-8600 and faxes to (202) 906-8669.

Address all correspondence to Dykema Gossett PLLC, Suite 300 West, 1300 I Street, N.W., Washington, D.C. 20005-3306.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First Joint Inventor	Inventor's Signature	Date
Steen Brabrand RASMUSSEN		
Residence:	Citizenship	
Birkholmvej 1, DK-3540, Lynge, DENMARK	Danish	
Post Office Address:		
Same as above		

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For your information

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Sincerely Yours

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